Integrating Sciences through Energy

Summer, 2013; 3 Graduate Credits

Instructors: Bob Chen, Rob Stevenson, Bala Sundaram

Location: UMassBoston—TBD

Course Description:
This course is a graduate-level science content course designed for K-12 teachers and contextualized to the standards/inquiry-based curricula. It provides graduate-level content while modeling sound pedagogy. Using current and future curriculum materials, as well as State and National standards including the new Framework and Next Generation Science Standards for the teaching of science at the K-12 level, this course offers an in-depth exploration of fundamental principles of energy as they relate to biological, physical, chemical, and earth sciences. Special emphasis will be placed on the interdisciplinary relationships among these topics so that energy can be used to integrate across the disciplinary sciences. Students will be exposed to the current state of knowledge in the scientific community through laboratory activities, outside readings, classroom presentations, and in-depth discussions with classmates. Students will participate in hands-on, inquiry based exercises drawn from National science standards-based instructional materials which will allow them to review these teaching materials and methods, as well as develop research-based strategies for communicating with students, especially English language learners and students with other special needs.

Lesson 1	Forms of Energy - Intro	Kinetic Energy, Potential Energy, Thermal energy, Gravity, work/force/motion/power	Introduction, Pre-Assessment, Rube-Goldberg Devices, dropping a ball
Lesson 2	Heat-Radiation	Radiative heat transfer, thermal time constant	Heat lamps, energy beads, coffee cups
Lesson 3	Heat-Energy Budgets	Conservation of energy, steady state, equilibrium	Light bulb, burn a peanut
Lesson 4	Heat-Modes of Heat Transfer	Latent heat of evaporation, transpiration, conduction,	Wet T-shirt Contest, How to construct a pot, Albedo, boiling water

Lesson 5	Heat-Plate Tectonics	Convection, heat transfer, tectonics, Entropy, chaos, endothermic/exothermic reactions, mixing	Lava lamps, food tectonics, hot chocolate
Lesson 6	Heat-Star Evolution	Cosmic abundance of elements, fission/fusion, gravitational collapse, E=mc2, nuclear energy	Origins of Life, search for life, supernovae
Lesson 7	Forms of Energy-Earth	Radiative budget, photosynthesis, Solar Energy, Chemical Energy, Organic Compounds Global climate change, heat transfer activation energy, hurricanes	Ecosystem flow software, DaisyWorld, Computer Simulations
Lesson 8	Forms of Energy-Rube Goldberg	Phase changes/Heat of fusion, ideal gases, chemical reactions, friction, vacuum, closed systems Electrical Energy, gases	Lighting a light bulb with a pickle, Rubbing hands with/without moisturizer, hot wheels
Lesson 9	Systems-Cycles	Carbon and water cycles, EcoSphere to Biosphere, Trophic Levels	Boiling water, Superheating water, EcoBeaker
Lesson 10	Systems-Bicycles	Gears, units and scales, work	Motors
Lesson 11	Systems-Metabolism	Energy history, cellular respiration, digestive system, aerobic/anaerobic, warm-blooded animals, metabolism, reproduction	Peanut butter sandwich, gasoline calculations, Pendulum to face, bomb calorimeter

Lesson 12	Perpetual Motion Machines	Energy needs, inventions, power sources, Solar energy, wind, geothermal, biofuels, refrigerators	Cape Wind, Photovoltaic Cells
Lesson 13	Teaching Energy Units	Group Peer Teaching	ALL students

References:

Energy: Stop Faking It! Robertson, W.C., NSTA, 2002.
Miscellaneous readings

Assignments:

Readings will be drawn from primary literature sources as well as background reading from activities. There will not be a single text although appropriate chapters of textbooks may be assigned. Participants will be required to implement at least one lesson plan/energy activity.

Evaluation:

The course grade will consist of a take-home midterm (25%), take-home final (35%), implementation of an energy lesson (20%) and active class participation (20%). Content knowledge will be emphasized on the exams. Reflection and observations of classroom experiences with lesson plans will be an important component of the latter two criteria.

Lesson Plan:

Teachers will be required to design and implement a 20-30 minute lesson plan aimed to teach one of the eight major concepts in Environmental Science. The lesson plan must follow the template for a lesson plan (this will be designed the first day of class). Following the lesson plan, fellow students will be required to assess the effectiveness of both the lesson plan as well as the implementation of it (a template for this evaluation will also be developed in class).